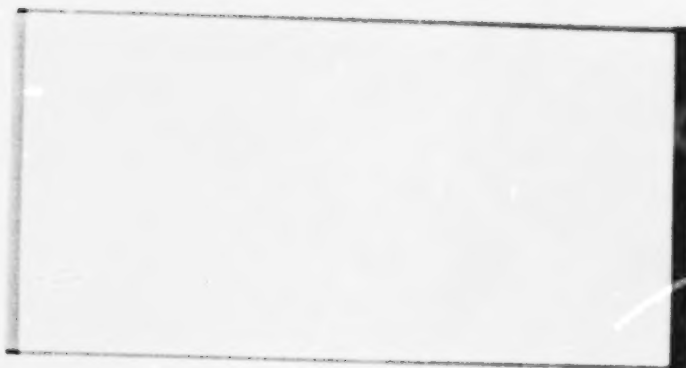
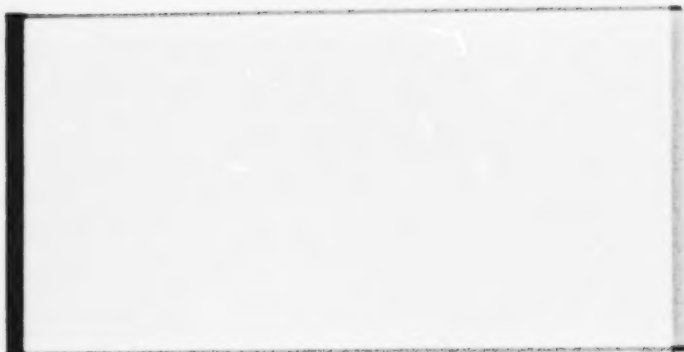




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PICKERING ROUND WHITEFISH STUDIES  
FIELD COMPONENT, 1981-82

Report No 82-539-K

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ABSTRACT

A study requested by Environmental Studies and Assessments Department of Design and Development Division was conducted to monitor the relative abundance of round whitefish (*Prosopium cylindraceum*) in the Pickering area during the spawning season, and to develop an efficient technique for sampling round whitefish larvae. Eighty-two (82) round whitefish, including 29 ripe males and 8 ripe females, were taken by gill net in the nearshore waters of Ross Point, near Whitby, during November and December 1981. Four and five year old fish dominated the catch. Growth curves for round whitefish captured at Darlington during 1977 and at Pickering during 1979, 1980 and 1981 were similar. The majority of round whitefish were taken at the 7 m depth contour indicating that spawning may occur shoreward of the 10 m depth contour near Ross Point. Round whitefish abundance was greatest when surface water temperatures were between 3.0°C and 4.5°C; however, spawning was probably delayed until water temperature dropped below 3.0°C. A single larval round whitefish was captured on May 13, 1981 during a night tow with the benthic sled.

| job            | file        | date             | report no. |
|----------------|-------------|------------------|------------|
| 740634-103-492 | 837.321 PIC | January 20, 1983 | 82-539-K   |

## TABLE OF CONTENTS

|                          | <u>Page</u> |
|--------------------------|-------------|
| 1.0 INTRODUCTION         | 1           |
| 2.0 METHODS              | 1           |
| 2.1 Gill Net Survey      | 1           |
| 2.2 Larval Fish Sampling | 3           |
| 3.0 RESULTS              | 6           |
| 3.1 Gill Net Survey      | 6           |
| 3.2 Larval Fish Sampling | 7           |
| 4.0 DISCUSSION           | 7           |
| 5.0 SUMMARY              | 10          |
| 6.0 CONCLUSIONS          | 10          |
| REFERENCES               | 12          |
| APPENDICES               | 13          |
| DISTRIBUTION             | - last -    |



## ontario hydro research division

To Dr. W.R. Effer  
Manager  
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Design & Development Div

### PICKERING ROUND WHITEFISH STUDIES FIELD COMPONENT, 1981-82

#### 1.0 INTRODUCTION

Previous whitefish spawning surveys conducted in the vicinity of Pickering Nuclear Generating Station (NGS) indicated that round whitefish (*Prosopium cylindraceum*) in spawning condition frequented the inshore region between Frenchman's Bay and Ross Point (Thickson Point) near Whitby, during November and December when water temperatures ranged between 2°C and 8°C (Ontario Ministry of Natural Resources, 1980; Ontario Hydro Research Division Report No C82-42-K, 1982). The presence of ripe round whitefish (and one spent female round whitefish in December, 1980) in relatively shallow inshore waters suggests that spawning may occur in the nearshore area of Lake Ontario near Pickering, particularly off Ross Point where maximum round whitefish abundance was recorded.

Additional research was requested by the Environmental Studies and Assessment Department of Design and Development Division to further document the occurrence of round whitefish in the Pickering area during late fall. One of the objectives of the study was to monitor the relative abundance of round whitefish during the spawning season using a standard method. The catch of round whitefish will represent an annual index of abundance for the Pickering area. Another objective was to develop an efficient technique for sampling round whitefish larvae. The third aspect of the 1981-1982 round whitefish studies was the determination of salient features of round whitefish larval behaviour in laboratory experiments and is addressed in a separate report (Ontario Hydro Research Division Report - in draft).

The Ross Point area is situated approximately 12 km east of Pickering NGS 'A' on the north shore of Lake Ontario, just east of Whitby Harbour (Figure 1). Substrate is mainly composed of glacial sediment with particles ranging in size from clay to boulder, as is characteristic of the entire Pickering nearshore zone (Ontario Hydro Research Division Report 79-165-K).

#### 2.0 METHODS

##### 2.1 Gill Net Survey

Experimental gill nets were set once weekly at Ross Point from November 18, 1981 to December 15, 1981. Each gill net, consisting

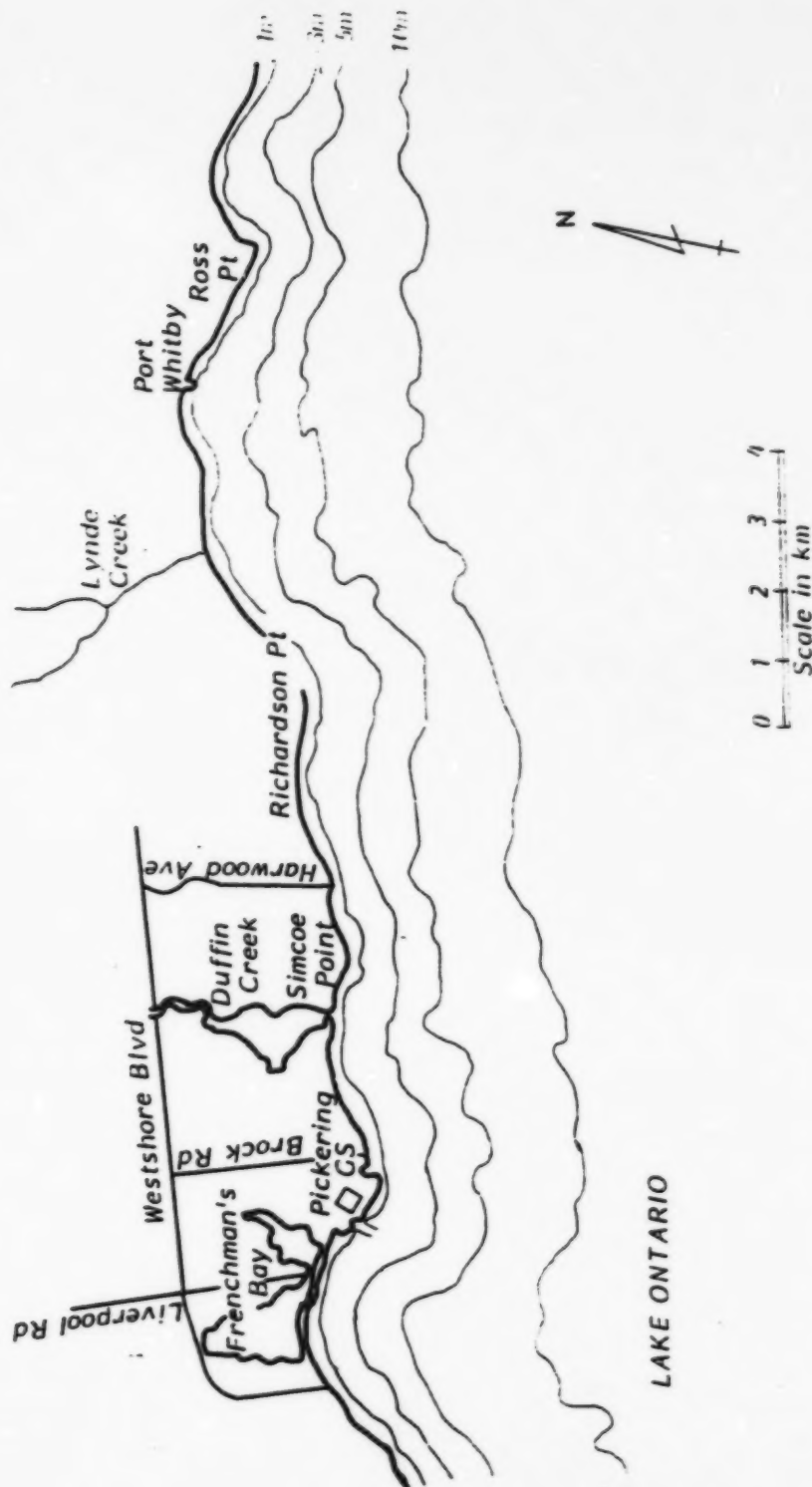


FIGURE 1  
LOCATION OF ROSS POINT SAMPLING AREA  
PICKERING ROUND WHITEFISH STUDIES 1981 - 1982

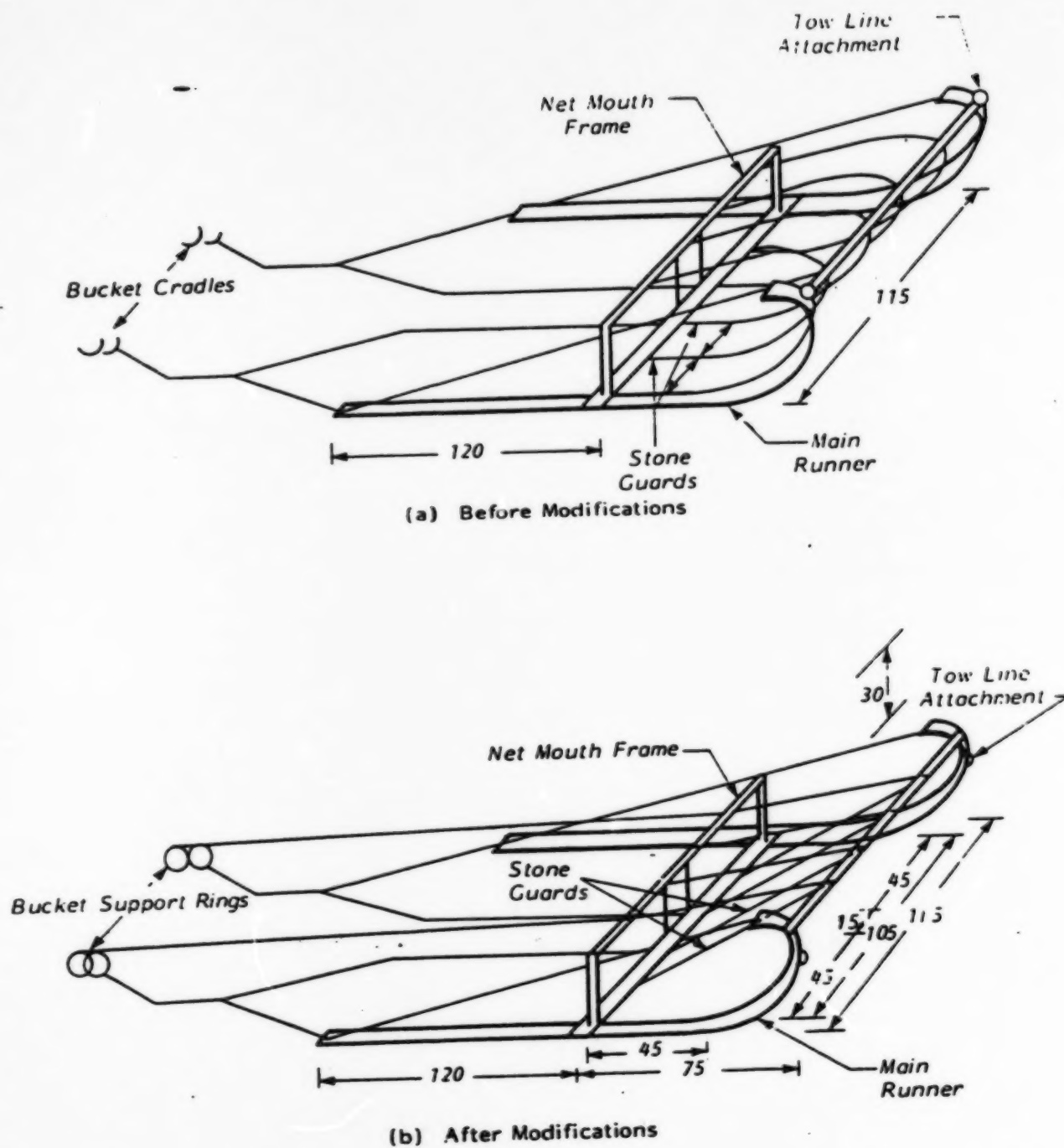
of six 15 m panels of 6.3 to 12.7 cm stretched mesh in increments of 1.3 cm, was set perpendicular to shore for a 24 h period. The two gangs of nets were set with the inshore ends located at the 3 m and 7 m depth contours respectively. Rough weather caused a delay in retrieving gill nets during the week of November 30, 1981, resulting in a 72 h set instead of the planned 24 h set.

Scale samples were collected and fork lengths and weights measured for round whitefish captured during the fall period. Salmonid scales were sent to the Ontario Ministry of Natural Resources for ageing. Round whitefish scales were subjected to age analysis within the Biological Research Section. Only 52 round whitefish could be aged since the 72 h set on December 3 caused some fish to deteriorate to the point where scale samples could not be obtained. Data obtained were used to establish round whitefish growth characteristics and age structure. The state of sexual maturity of each round whitefish aged was indicated as either immature, mature or ripe males and females. Surface water temperature ( $^{\circ}\text{C}$ ) was measured at the end of each gill net set.

## 2.2 Larval Fish Sampling

The capture efficiency of three types of larval fish sampling gear was compared in 1982. These were a 0.5 m diameter conical plankton net with 363  $\mu$  mesh size, a 1.0 m diameter conical tow net with 1000  $\mu$  mesh size, and a benthic sled to which 0.5 m tow nets (363  $\mu$  mesh size) were attached. The benthic sled apparatus is depicted in Figure 2. Initial design features of the sled included two curved bottom outside runners, a double rectangular frame for anterior net attachment, curved bars in front of frames to exclude large stones, crossbars for support and stability, double semicircular bands for posterior attachment of net buckets, and small rings welded to the top and front of each runner for connecting the towing bridle (Figure 2a). Later modification of the apparatus to facilitate a better towing angle and less structural damage due to large stones and boulders involved shifting the two rings to a more forward position, changing the curved bars to straight bars oriented diagonally from the foremost crossbar to the bottom of the double net frame, and use of complete rings to house the net buckets (Figure 2b).

Table I represents a summary of the sampling effort expended by gear type during the larval fish survey, including the theoretical volume of water sampled. The volume of water sampled was measured by suspending flowmeters in the mouth of each net. The benthic sled and large plankton tow net were deployed from April 8 to May 21, while the 0.5 m conical net was only used on the final sampling date. The sampling strategy followed was to use the 1.0 m tow net in conjunction with the benthic sled until larval round whitefish were first captured, then increase the sampling effort with the addition of the 0.5 m net. Although conical nets were towed at the surface and near bottom, it was the function of the benthic sled apparatus to sample the lake bottom directly. A benthic sampling device was considered necessary since round whitefish larvae may remain on the lake bottom after hatching (Normandeau, 1969). All larval sampling was performed during the day except for the last three sampling sessions which were conducted at night.



Dimensions in cm

**FIGURE 2**  
**BENTHIC SLED DESIGNED FOR LARVAL FISH COLLECTION**

**TABLE I**  
**SUMMARY OF SAMPLING EFFORT EXPENDED DURING**  
**PICKERING LARVAL WHITEFISH STUDY, 1982**

| <u>Date</u>  | <u>Day (D)</u><br><u>Night (N)</u> | <u>Tow</u><br><u>Duration</u><br><u>(Each)</u> | <u>Gear Type</u>           | <u>Contour</u><br><u>Depth</u><br><u>(m)</u> | <u>No of</u><br><u>Samples</u> | <u>Theoretical</u><br><u>Vol of Water</u><br><u>Sampled</u><br><u>(m<sup>3</sup>)</u> |
|--------------|------------------------------------|------------------------------------------------|----------------------------|----------------------------------------------|--------------------------------|---------------------------------------------------------------------------------------|
| Apr 8        | D                                  | 5 min                                          | Benthic sled (duplicated)  | 1,4,7                                        | 6                              | 360                                                                                   |
|              |                                    |                                                | 1 m diam tow net (dup)     | 1,4,7                                        | 6                              | 1,416                                                                                 |
|              |                                    |                                                | 1 m diam tow net (dup)     | (surface)                                    | 4                              | 944                                                                                   |
|              |                                    |                                                |                            | 4,7                                          | 16                             | 2,720                                                                                 |
|              |                                    |                                                |                            | (bottom)                                     |                                |                                                                                       |
| 14           | D                                  | 5 min                                          | "                          | "                                            | "                              | "                                                                                     |
| 19           | D                                  | "                                              | "                          | "                                            | "                              | "                                                                                     |
| 26           | D                                  | "                                              | "                          | "                                            | "                              | "                                                                                     |
| 30           | D                                  | "                                              | "                          | "                                            | "                              | "                                                                                     |
| May 4        | D                                  | "                                              | "                          | "                                            | "                              | "                                                                                     |
| 7            | D                                  | "                                              | "                          | "                                            | "                              | "                                                                                     |
| 10           | D                                  | "                                              | "                          | "                                            | "                              | "                                                                                     |
| 11           | N                                  | "                                              | "                          | "                                            | "                              | "                                                                                     |
| 13           | N                                  | "                                              | Benthic sled (duplicate)   | 1,4,7                                        | 6                              | 360                                                                                   |
|              |                                    |                                                | Benthic sled (2 dup)       | 7 - 1*                                       | 4                              | 480                                                                                   |
|              |                                    |                                                | 1 m diam tow net (dup)     | 1,4,7                                        |                                |                                                                                       |
|              |                                    |                                                |                            | (surface)                                    | 4                              | 1,416                                                                                 |
|              |                                    |                                                | 1 m diam tow net (dup)     | 4,7                                          |                                |                                                                                       |
|              |                                    |                                                |                            | (bottom)                                     | 2                              | 944                                                                                   |
|              |                                    |                                                | 1 m diam tow net (dup)     | 7 - 1*                                       | 22                             | 3,440                                                                                 |
|              |                                    |                                                |                            | (surface)                                    |                                |                                                                                       |
| 20           | N                                  | "                                              | Benthic sled (2 dup)       | 1,4,7                                        | 12                             | 720                                                                                   |
|              |                                    |                                                | Benthic sled (2 dup)       | 7 - 1*                                       | 4                              | 480                                                                                   |
|              |                                    |                                                | 1 m diam tow net (2 dup)   | 1,4,7                                        | 12                             | 2,832                                                                                 |
|              |                                    |                                                |                            | (surface)                                    | 8                              | 1,888                                                                                 |
|              |                                    |                                                | 1 m diam tow net (2 dup)   | 4,7                                          |                                |                                                                                       |
|              |                                    |                                                |                            | (bottom)                                     | 4                              | 1,888                                                                                 |
|              |                                    |                                                | 1 m diam tow net (2 dup)   | 7 - 1*                                       |                                |                                                                                       |
|              |                                    |                                                |                            | (surface)                                    | 12                             | 720                                                                                   |
|              |                                    |                                                | 0.5 m diam tow net (2 dup) | 1,4,7                                        |                                |                                                                                       |
|              |                                    |                                                |                            | (surface)                                    | 8                              | 480                                                                                   |
|              |                                    |                                                | 0.5 m diam tow net (2 dup) | 4,7                                          |                                |                                                                                       |
|              |                                    |                                                |                            | (bottom)                                     |                                |                                                                                       |
|              |                                    |                                                |                            |                                              | 60                             | 9,008                                                                                 |
|              |                                    |                                                |                            |                                              | 226                            | 36,928                                                                                |
| <b>TOTAL</b> |                                    |                                                |                            |                                              |                                |                                                                                       |

\* These larval tows were made from the 7 m to the 1 m depth contour.

### 3.0 RESULTS

#### 3.1 Gill Net Survey

A total of 95 fish were caught in gill nets during the five weeks of fall sampling near Ross Point. Round whitefish (*Prosopium cylindraceum*) was the most abundant species, with 82 fish captured. Other fish taken were five white sucker (*Catostomus commersoni*) two brown trout (*Salmo trutta*), and one each of lake whitefish (*Coregonus clupeaformis*), rainbow trout (*Salmo gairdneri*), yellow perch (*Perca flavescens*), white bass (*Morone chrysops*), smelt (*Osmerus mordax*) and splake (*Salvelinus fontinalis* x *S. namaycush*). Complete catch data is contained in Appendix 1.

Round whitefish were taken on November 18, December 3 and December 10, 1981. On the first occasion, one round whitefish was captured at the 3 m depth contour while three others were caught at the 7 m depth contour. The surface water temperature was 5.8°C at the time gill nets were hauled. Round whitefish occurred in largest numbers at the 7 m depth contour on December 3, when 68 fish were taken, and surface water temperature was 4.5°C. On December 15, when surface water temperature dropped to 3.0°C, 10 round whitefish were caught at the 7 m depth contour. The single lake whitefish was taken at the 3 m depth contour on November 18.

A comparison of the age distribution of round whitefish captured at Pickering during 1979, 1980 and 1981 is provided in Table II. Four and five-year olds were prominent in the 1981 catch, three, four and five year olds dominated the 1980 catch, two-year old fish accounted for the largest portion of the 1979 catch. These data suggest that the 1976 and 1977 year classes were stronger than other year classes for which data is available. Absence of age two fish in the 1981 catch may be an early indication of a poor 1979 year class. The 1978 year class was not well-represented in either the 1980 or 1981 round whitefish catches.

TABLE II

COMPARISON OF AGE DISTRIBUTION OF ROUND WHITEFISH  
TAKEN AT PICKERING DURING 1979, 1980 AND 1981

| Survey Year                     | Age         |              |              |              |              |              |             |             | Total |
|---------------------------------|-------------|--------------|--------------|--------------|--------------|--------------|-------------|-------------|-------|
|                                 | 1+          | 2+           | 3+           | 4+           | 5+           | 6+           | 7+          | 8+          |       |
| Pickering, 1979<br>(Year Class) | 0<br>(1978) | 17<br>(1977) | 9<br>(1976)  | 0<br>(1975)  | 2<br>(1974)  | 11<br>(1973) | 3<br>(1972) | 1<br>(1971) | 43    |
| Pickering, 1980<br>(Year Class) | 1<br>(1979) | 6<br>(1978)  | 73<br>(1977) | 24<br>(1976) | 36<br>(1975) | 9<br>(1974)  | 0<br>(1973) | 0<br>(1972) | 149   |
| Pickering, 1981<br>(Year Class) | 0<br>(1980) | 0<br>(1979)  | 7<br>(1978)  | 19<br>(1977) | 14<br>(1976) | 5<br>(1975)  | 7<br>(1974) | 0<br>(1973) | 52    |

The proportion of male to female round whitefish in the sample of aged fish from the 1981 catch was approximately 4:1, compared with a nearly 1:1 sex ratio for 1980 fish, and a 2:1 sex ratio for 1979 fish. For the 1981 survey, 29 males and 8 females were ripe with free-flowing sexual products, and the remaining fish were all mature. No spent fish were captured in 1981.

Figure 3 compares the mean fork length at age of round whitefish caught at Darlington in 1977 and at Pickering during 1979, 1980 and 1981. Fork length data are presented in Appendix 2. Growth appeared to be slightly faster for the fish captured at Darlington (Ontario Hydro Research Division Report 78-48-K) and at Pickering during 1980, especially for fish older than 3 years. The smaller sample sizes of the Pickering 1979 and 1981 round whitefish surveys may account for the difference in growth curves; however, it is possible that a real variation in absolute growth of these fish with age is reflected.

### 3.2 Larval Fish Sampling

Despite a large sampling effort entailing the sampling of 37,529 m<sup>3</sup> of lakewater, only one larval round whitefish was caught on May 13, 1982 at the 1 m depth contour off Ross Point. Complete larval fish catch data are contained in Appendix 3. The larval round whitefish was captured during a night tow using the benthic sled apparatus and was 16 mm in total length. Three white sucker (*Catostomus commersoni*) larvae were also caught, one on May 11 and two on May 13, 1982. A total of 500 smelt (*Osmerus mordax*) eggs were taken during the larval fish survey, and were distributed both inshore (1 m depth contour) and offshore (3 m and 7 m depth contour). During the three night sampling sessions (May 11, 13 and 20, 1982) a total of 768 adult sculpins (a mixture of mottled sculpin (*Cottus bairdi*) and slimy sculpins (*Cottus cognatus*) were caught exclusively in benthic sled tows at all depth contours sampled. Undetermined quantities of amphipods of the genus *Gammarus* and mysids of the genus *Mysis* were also present in benthic sled samples. A total of 126 sculpin eggs were taken on May 20 during a benthic sled tow at the 1 m depth contour.

### 4.0 DISCUSSION

The catch of 82 round whitefish in nearshore waters off Ross Point during November and December 1981 is consistent with the previous year's catch at the same location (78) (Ontario Hydro Research Division Report C82-42-K). Only 21 round whitefish were captured off Ross Point in 1979, although the level of fishing effort was higher than in subsequent years (Ontario Ministry of Natural Resources, 1980). Increasing catches of round whitefish may indicate a greater relative abundance of prespawning fish in the Ross Point area. However, fish vulnerability probably increased in 1981 as a consequence of the unplanned 72 h gill net set which resulted in a catch of 68 round whitefish. Gill nets set for more than 24 h may produce greater catches because prespawning fish may either avoid nets initially or move inshore in small groups on a daily basis. Bryan and Kato (1975) reported that spawning activity was interrupted by gillnetting and egg collecting on round whitefish spawning grounds.

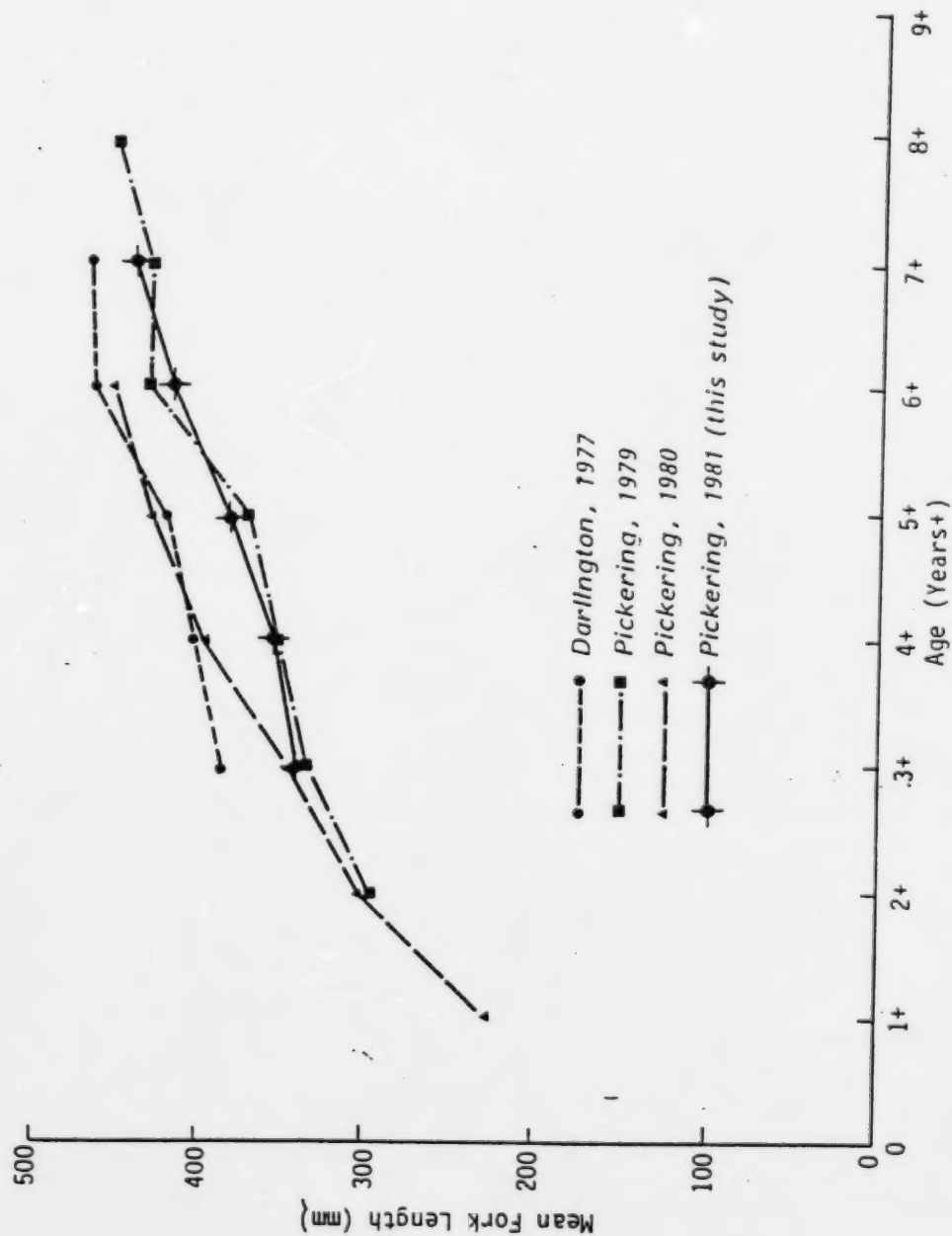


FIGURE 3  
COMPARISON OF GROWTH OF ROUND WHITEFISH  
AT DARLINGTON, 1977 AND PICKERING, 1979, 1980 AND 1981

Recurrence of round whitefish in spawning condition near Ross Point in consecutive years is an indication that spawning sites exist in that area. Since gill nets set from the 3 m, 7 m and 10 m depth contours captured round whitefish during the 1979-1981 sampling periods, it is probable that spawning occurs shoreward of the 10 m depth contour. Normandeau (1969) found that round whitefish of Newfound Lake, New Hampshire spawned in a shallow (1 m depth) rocky reef area, while Bryan and Kato (1975) noted that round whitefish spawned on gravel in fast current at depths of less than 2 m in a Yukon Territory lake. Scott and Crossman (1973) reported that round whitefish spawned over gravel at depths of 6 - 7 m. Insufficient evidence exists at present to more accurately define the round whitefish spawning depth off Ross Point.

The relative abundance of round whitefish at a single location could fluctuate due to year-to-year changes in spawning site selection and consequently mask true year class strength variation. Apparently, suitable substrates are available all along the north shore of Lake Ontario (Ontario Hydro Research Division Report 79-165-K).

Water temperature can affect both the timing and location of fish spawning and may be related to the lack of spent fish in the 1981 catch. Surface water temperature did not fall below 3.0°C during the 1979 and 1981 Pickering surveys. However, during the 1980 survey when water temperatures between 2.0°C and 3.0°C were recorded, a large catch of round whitefish including one spent fish was netted off Ross Point (Ontario Hydro Research Division Report C82-42-K). Other studies have shown that water temperature is less than 3.0°C during the peak spawning period of round whitefish (Normandeau, 1969; Bryan and Kato, 1975). Since no spent fish were captured, and the lake temperature did not reach 3.0°C until December 15, 1981, peak spawning activity may have been delayed. The sex ratios observed in different years may be related to the ambient lake temperature on the spawning grounds. A smaller proportion of females was noted among 1981 fish compared to 1980 fish. Arrival of large numbers of female fish may signal the onset of spawning at or below 3°C.

Laboratory rearing of round whitefish larvae has demonstrated that the newly-hatched larvae have a pronounced preference for a sandy substrate (Ontario Hydro Research Division Report - in draft). A similar phenomenon was observed for round whitefish larvae in Newfound Lake (Normandeau, 1969).

Both 0.5 m and 1.0 m conical tow nets did not effectively sample the lake bottom since towing speed was reduced when these nets were dragged over the lake bottom. Additionally, the conical nets suffered substantial mechanical damage, which probably affected their filtration efficiency. However, the benthic sled apparatus, after modifications to improve subsurface handling and stability, operated well on the lake bottom, being easily towed over a sandy substrate. Where the benthic sled encountered obstacles such as rocks and boulders, a slight increase in boat speed was necessary to lift the sled over the obstacles, and constant towing speed was resumed. The occurrence

of numerous adult sculpins in benthic sled samples is good evidence that the benthic sled apparatus operated effectively. Deployment of the benthic sled from late March to mid-May may be a feasible sampling strategy if larval round whitefish remain on or near a sandy substrate after hatching. The possibility of net avoidance by larvae which enter gravel or cobble interstices may be reduced by modifying the benthic sled such that the top few centimetres of substrate preceding the sled are disturbed during sampling. This technique may uncover round whitefish eggs if employed before the anticipated spring hatching date.

Round whitefish are known to spawn in areas affected by substantial current activity (Normandeau, 1969; Bryan and Kato, 1975). Although round whitefish eggs are negatively buoyant, drifting eggs were collected during the day by Bryan and Kato (1975).

If the locations where round whitefish aggregate, eg Ross Point, are associated with pronounced currents, longshore or offshore dispersal of eggs may immediately follow fall spawning. These events could contribute to the paucity of round whitefish larvae in inshore waters during the spring.

#### 5.0 SUMMARY

The incidence of prespawning round whitefish was again demonstrated in the nearshore area off Ross Point during November and December 1981 when 82 fish were caught. Fish which frequented this area during 1981 had a similar growth pattern to fish captured in the same vicinity during the 1979 survey, but exhibited slightly slower growth than Pickering 1980 and Darlington 1977 fish, particularly for fish older than 3 years. Round whitefish in the Pickering area probably spawned shoreward of the 10 m depth contour. The majority of round whitefish were taken at the 7 m depth contour, with 29 ripe males and 8 ripe females collected. Surface water temperature was 3.0°C as late as December 15, 1981 and thus may have delayed spawning activities since no spent round whitefish were captured.

A single larval round whitefish, 16 mm in total length, was taken at the 1 m depth contour during a night tow with the benthic sled on May 13, 1982. Large incidental catches of adult sculpins occurred during night tows with the benthic sled. Over 37,000 m<sup>3</sup> of lakewater was sampled during the entire larval fish survey.

#### 6.0 CONCLUSIONS

1. The 1977 year class of round whitefish was a relatively strong one, whereas the 1979 year class may have a poor showing in future surveys.
2. At Ross Point the presumed spawning depth is shoreward of the 10 m depth contour.
3. Preferred spawning temperature is probably less than 3°C.

4. The benthic sled apparatus appears to have some potential as a device for capturing larval round whitefish, but more extensive sampling during the spring is necessary to demonstrate its effectiveness.

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# APPENDIX 1

## FISH CATCH IN 24 HR GILL NET SETS PICKERING ROUND WHITEFISH STUDY, 1981-1982

| <u>Date</u>       | <u>Contour<br/>Depth (m)</u> | <u>Species</u>                                    | <u>Number</u> | <u>Water Temperature<br/>(°C)</u> |
|-------------------|------------------------------|---------------------------------------------------|---------------|-----------------------------------|
| November 18, 1981 | 3                            | Round Whitefish<br>Lake Whitefish<br>White Sucker | 1<br>1<br>3   | 5.8                               |
|                   | 7                            | Round Whitefish<br>White Sucker                   | 3<br>2        | 5.8                               |
| November 24, 1981 | 3                            | -                                                 | -             | 4.5                               |
|                   | 7                            | Splake                                            | 1             | 5.0                               |
| December 3, 1981* | 3                            | Rainbow Trout<br>Brown Trout<br>Yellow Perch      | 1<br>2<br>1   | 4.0                               |
|                   | 7                            | Round Whitefish<br>White Bass<br>Smelt            | 68<br>1<br>1  | 4.5                               |
| December 8, 1981  | 3                            | -                                                 | -             | 3.8                               |
|                   | 7                            | -                                                 | -             | 4.2                               |
| December 15, 1981 | 3                            | -                                                 | -             | 2.5                               |
|                   | 7                            | Round Whitefish                                   | 10            | 3.0                               |

Total Number of Fish Caught = 95  
Total Number of Round Whitefish = 82

\* 72 hr set on this date

APPENDIX 2

GROWTH PARAMETERS FOR ROUND WHITEFISH  
CAPTURED AT DARLINGTON, 1977 AND PICKERING, 1979, 1980 AND 1981

| Mean Fork<br>Length<br>(mm) | Age (Years+) |     |     |     |     |     |     |     |
|-----------------------------|--------------|-----|-----|-----|-----|-----|-----|-----|
|                             | 1+           | 2+  | 3+  | 4+  | 5+  | 6+  | 7+  | 8+  |
| Darlington<br>1977          | -            | -   | 383 | 405 | 421 | 467 | 486 | -   |
| Pickering<br>1979           | -            | 296 | 334 | -   | 373 | 429 | 430 | 456 |
| Pickering<br>1980           | 227          | 303 | 346 | 396 | 433 | 456 | -   | -   |
| Pickering<br>1981           | -            | -   | 340 | 355 | 380 | 418 | 440 | -   |

APPENDIX 3

LARVAL FISH CATCH - PICKERING ROUND WHITEFISH STUDY, 1981-1982

| Gear Type     | Contour Depth (m) |        | A P R I L (1982) |    |    |    |                |  |  | M A Y (1982) |                |                |                   |                                    |                                      |                 |
|---------------|-------------------|--------|------------------|----|----|----|----------------|--|--|--------------|----------------|----------------|-------------------|------------------------------------|--------------------------------------|-----------------|
|               | Surface           | Bottom | 8                | 14 | 19 | 26 | 30             |  |  | 4            | 7              | 10             | 11*               | 13*                                |                                      | 20*, p          |
| Benthic Sled  |                   | 1      | 0                | 0  | 0  | 0  | 0              |  |  | 0            | 0              | 0              | 27 <sup>c,d</sup> | 11 <sup>c</sup> ; 1 <sup>f</sup>   | 126 <sup>h,a</sup> ; 67 <sup>c</sup> |                 |
|               |                   | 4      | 0                | 0  | 0  | 0  | 3 <sup>a</sup> |  |  | 0            | 0              | 8 <sup>a</sup> | 22 <sup>c,d</sup> | 6 <sup>a</sup> ; 87 <sup>c</sup>   | 2 <sup>a</sup> ; 47 <sup>c</sup>     |                 |
|               |                   | 7      | 0                | 0  | 0  | 0  | 0              |  |  | 0            | 0              | 3 <sup>a</sup> | 52 <sup>c,d</sup> | 16 <sup>a</sup> ; 44 <sup>c</sup>  | 6 <sup>a</sup> ; 68 <sup>c</sup>     |                 |
|               |                   | 7-1    |                  |    |    |    |                |  |  |              |                |                |                   | 2 <sup>a</sup> ; 160 <sup>c</sup>  | 5 <sup>a</sup>                       |                 |
|               |                   | 7-1    |                  |    |    |    |                |  |  |              |                |                |                   | 11 <sup>a</sup> ; 183 <sup>c</sup> | 4 <sup>a</sup>                       |                 |
| 1.0 m Tow Net | 1                 |        | 0                | 0  | 0  | 0  | 0              |  |  | 0            | 1 <sup>a</sup> | 0              | 0 <sup>d</sup>    | 20 <sup>a</sup> ; 1 <sup>e</sup>   | 11 <sup>a</sup>                      |                 |
|               | 4                 |        | 0                | 0  | 0  | 0  | 0              |  |  | 0            | 0              | 0              | 0 <sup>d</sup>    | 27 <sup>a</sup> ; 1 <sup>e</sup>   | 49 <sup>a</sup>                      |                 |
|               | 7                 |        | 0                | 0  | 0  | 0  | 0              |  |  | 0            | 0              | 0              | 0 <sup>d</sup>    | 24 <sup>a</sup>                    | 40 <sup>a</sup>                      |                 |
|               |                   | 4      | 0                | 0  | 0  | 0  | 0              |  |  | 0            | 1 <sup>a</sup> | 0              | 0 <sup>d</sup>    | 18 <sup>a</sup>                    | 67 <sup>a</sup>                      |                 |
|               |                   | 7      | 0                | 0  | 0  | 0  | 0              |  |  | 0            | 0              | 3 <sup>b</sup> | 1 <sup>e</sup>    | 55 <sup>a</sup>                    | 85 <sup>a</sup>                      |                 |
| 0.5 m Tow Net | 7-1               |        |                  |    |    |    |                |  |  |              |                |                |                   | 0                                  | 2 <sup>a</sup>                       |                 |
|               | 1                 |        |                  |    |    |    |                |  |  |              |                |                |                   |                                    |                                      | 10 <sup>a</sup> |
|               | 4                 |        |                  |    |    |    |                |  |  |              |                |                |                   |                                    |                                      | 2 <sup>a</sup>  |
|               | 7                 |        |                  |    |    |    |                |  |  |              |                |                |                   |                                    |                                      | 3 <sup>a</sup>  |
|               |                   | 4      |                  |    |    |    |                |  |  |              |                |                |                   |                                    |                                      | 12 <sup>a</sup> |
|               |                   | 7      |                  |    |    |    |                |  |  |              |                |                |                   |                                    |                                      | 3 <sup>a</sup>  |

a - smelt eggs (total = 500)  
b - yellow perch eggs (total = 3)  
c - adult sculpin (total = 768)  
d - mysids and/or gammarids present  
e - white sucker larvae (total = 3)  
f - round whitefish larvae (total = 1)

\* - night sampling on these dates  
p - paired, duplicate two conducted on this date  
h - sculpin eggs (total = 126)

**POOR**

**QUALITY**

**ORIGINAL**

